

Genetic Studies in Relation to Kuru.
IV. Dermatoglyphics of the Fore and Anga Populations
of the Eastern Highlands of New Guinea

C. C. PLATO¹ AND D. C. GAJDUSEK²

Published information on the dermatoglyphics of the people of New Guinea is sparse. Price and MacIntosh [1] reported on the fingerprint patterns of 51 individuals of the Hula village near Port Moresby. A more detailed dermatoglyphic study involving palm print as well as fingerprint evaluation was conducted by Geipel [2]. It pertained to two different groups, the short-statured Ayom New Guineans who live in the Schrader Mountains of the Bismarck Range, and the New Guineans who live in the nearby valley of the Ramu River. The present report concerns a further two groups of New Guineans and, in addition, compares the dermatoglyphic patterns of people who are subject to the disease kuru [3] with those from an adjacent group totally free of it.

In the present study, finger- and palm-print data have been collected from the Fore and Keiagana groups of the kuru region and from the adjacent Anga (Kukukuku) group speaking the Simbari language. Detailed analysis of the finger- and palm-print patterns was carried out for 102 individuals of the kuru region who came from the following villages: in the South Fore region, 31 from Agakamata, 10 from Awarosa, and 12 from other villages (total 53); in the North Fore, 22 from Awande, 16 from Mage, and three from other villages (total 41); and from the Keiagana villages of Hogateru and Woioepa, three and five subjects, respectively. These villages lie in the area of high kuru incidence, and all subjects belong to families in which kuru has occurred in close relatives.

As a contrasting group, we have analyzed 64 sets of finger- and palm-prints from the nearby Anga (Kukukuku) groups of New Guinea Highlanders who live immediately adjacent to the region of maximal kuru incidence. They are, however, totally free of kuru [3, 4]. In fact, the Lamari River which separates these two peoples forms not only the sharpest demarcation between high incidence kuru and a complete absence of the disease here, but also one of the sharpest ethnolinguistic boundaries in New Guinea. The three Anga peoples studied belong to the Moraei (Dunkwi), Muniri, and Simbari groups of Simbari-language speakers, located adjacent to each other in the northwest extremity of the Anga region. The Fore and

¹ National Institute of Child Health and Human Development, Gerontology Branch, National Institutes of Health, Baltimore City Hospitals, Baltimore, Maryland 21224.

² National Institute of Neurological Diseases and Stroke, National Institutes of Health, Bethesda, Maryland 20014.

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most populations extending westward for several hundred miles all belong to the East New Guinea Highlands linguistic stock, which comprises many related families of New Guinea Highlands languages, including all groups affected with kuru. The Anga people belong to one of the few groups living in the highlands whose languages do not belong to the East New Guinea Highlands linguistic stock. They are by stature and other measurements, habitus, and facies, and by their markedly slow growth pattern, early aging, and extremely delayed puberty, quite distinct physically from the Fore kuru-afflicted people. Furthermore, the style of culture and general behavioral and personality type changes drastically at the boundary between Fore and Anga groups, making it one of the sharpest discontinuities between human types in New Guinea [3, 4].

The objective of the dermatoglyphic comparisons of these two groups is primarily to differentiate rather typical East New Guinea Highlands stock people, the Fore and Keiagana, from the adjacent people of the Anga linguistic family not belonging to this stock. Furthermore, any dermatoglyphic peculiarities that might be found in the Fore and Keiagana people will be of special interest in view of the occurrence of kuru in these groups.

RESULTS AND DISCUSSION

Fingerprints

The incidence of the digital dermatoglyphic patterns are given in table 1, together with their respective pattern intensity indices. The Anga group consistently showed higher frequencies of whorls in all digits, while the Fore exhibited more ulnar loops. The whorl-ulnar loop differences between the two populations when tested by χ^2 contingency tables were statistically significant ($P < .01$) for both the left- and right-hand comparisons. In individual digit-by-digit comparisons, the most significant differences were observed in the I and the V digits. The pattern-intensity indices were tested by the t -test, and they, too, were found to be significantly different ($P < .01$). The pattern-intensity index of the Anga, 16.3 for both hands, is higher than the 14.7 found among the Hula [1] and the 15.8 and 13.3 reported by Geipel [2] for the Ayom Pygmies and the Kanakas, respectively.

Palm Prints

The palm prints of the Fore and the Anga people were evaluated, and comparisons between them were made in terms of the main-line terminations, the frequency of patterns in the palmar configuration areas, the number of accessory triradii, and width of the atd angle.

The frequencies of the main-line terminations are presented in table 2. Contingency χ^2 tests indicated that the Fore and the Anga groups were significantly different from each other ($P < .01$) in terms of all the main-line terminations. The overall direction of the main lines and, consequently, of the palmar ridges was significantly more transverse among the Anga than the Fore.

The modal types of the D-line and the main-line indices of the two groups shown

TABLE 1

PERCENTAGE DISTRIBUTION OF FINGERPRINT PATTERNS AND PATTERN-INTENSITY INDEX
OF THE ANGA AND FORE PEOPLES OF NEW GUINEA

DIGIT	Left					Right				
	W	UL	RL	A	PII	W	UL	RL	A	PII
ANGA (N = 64)										
I	67.2	32.8	0	0	...	75.0	25.0	0	0	...
II	78.1	17.2	4.7	0	...	79.7	15.6	4.7	0	...
III	62.6	37.5	0	0	...	62.5	35.9	1.6	0	...
IV	78.1	21.8	0	0	...	84.3	15.7	0	0	...
V	20.4	79.6	0	0	...	21.9	78.1	0	0	...
All	61.3	37.8	0.9	0	8.06 ± .19	64.7	34.1	1.2	0	8.23 ± .18
FORE (N = 102)										
I	43.2	54.8	0	2.0	...	42.2	55.8	0	2.0	...
II	69.7	22.5	6.8	1.0	...	71.5	24.5	3.0	1.0	...
III	59.8	39.2	0	1.0	...	49.0	49.0	1.0	1.0	...
IV	70.5	28.4	1.0	0	...	72.5	27.5	0	0	...
V	12.8	87.2	0	0	...	9.8	90.2	0	0	...
All	51.1	46.5	1.6	0.8	7.51 ± .16	49.0	49.5	0.8	0.8	7.41 ± .14

NOTE.—W = whorl, UL = ulnar loop, RL = radial loop, A = arches, PII = pattern-intensity index.

in table 3 were tested by χ^2 and Student's *t*-test, respectively; their differences were found to be significant ($P < .01$). Table 3 also summarizes the frequencies of the modal types of the C line as described by Plato [5], with the Anga showing a significantly ($P < .01$) higher number of radial types than the Fore. The differences in the C-line terminations may be presented more conveniently in terms of the ratio of the radial modal types to the ulnar modal types (R/U ratio). This ratio is three times as high among the Anga as among either the Fore or the Ayom Pygmies (table 3). It should be noted that, despite their differences, both the Anga and the Fore have much higher R/U ratios in the right palms compared with the left. This is in line with the universal trend shown in our previous report [5].

The distribution of the patterns in the palmar-configuration areas are shown in table 4. The Anga group had a higher number of patterns in the III interdigital areas, whereas the Fore showed a higher incidence of patterns in the IV. These differences were more pronounced and gave significant values ($P < .01$) in the comparisons of the right palms as well as those for the left plus right (pooled). There were no significant differences in the incidences of patterns in the III and IV interdigital areas of the left hands as well as the hypothenar, thenar I, or the II interdigital of either hand. The number and location of the interdigital patterns of

TABLE 2
FREQUENCIES OF MAIN-LINE TERMINATIONS OF THE PALMS OF THE ANGA AND FORE (%)

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TABLE 3
MODAL TYPES OF THE C AND THE D LINES AND THE MAIN-LINE INDICES OF
ANGA, FORE, AND OTHER NEW GUINEA GROUPS

POPULATION AND HAND	MODAL TYPES OF THE C LINE*					MODAL TYPES OF THE D LINE			MAIN-LINE INDEX
	Absent (0)	Proximal (X,x)	Ulnar (5,6,7)	Radial (9,10,11)	R/U Ratio	7 (5,6,7)	9 (9,10)	11 (11,12,13)	
Anga:									
L	21.3	13.1	47.5	18.0	0.38	11.5	59.0	29.5	8.66 ± 0.26
R	13.1	11.5	26.2	49.2	1.88	9.8	34.4	55.7	9.74 ± 0.22
L + R	17.2	12.3	36.9	33.6	0.91	10.7	46.7	42.6	9.20 ± 0.18
Fore:									
L	17.7	12.5	59.4	10.4	0.18	36.5	49.0	14.6	7.66 ± 0.21
R	15.6	8.3	52.1	24.0	0.46	30.2	47.9	21.9	8.28 ± 0.20
L + R	16.7	10.4	55.7	17.2	0.30	33.3	48.4	18.2	7.97 ± 0.15
Ayom:									
L + R	16.0	7.6	55.3	17.7	0.31	22.4	45.4	32.0	8.78
Ramu River:									
L + R .....	...	...	...	...	...	27.4	49.2	23.4	8.32

* The present values of the modal types of the C line of the Anga and Fore are not identical to those given by Plato [5]. The small discrepancy is due to the addition of more data collected from this area since the last publication.

TABLE 4
FREQUENCY OF PATTERNS IN THE PALMAR CONFIGURATION AREAS OF THE ANGA AND FORE (%)

PALMAR CONFIGURATION AREA AND PATTERN	ANGA (N = 61)			FORE (N = 96)		
	L	R	L + R	L	R	L + R
Hypothenar:						
Vestiges	0	1.6	0.8	3.1	1.0	2.1
Loops	22.9	14.7	18.9	22.9	15.6	19.3
Thenar I:						
Vestiges	27.9	22.9	25.4	25.0	25.0	25.0
Loops	26.2	18.0	22.1	19.8	16.7	18.3
Interdigital II:						
Vestiges	1.6	1.6	1.6	3.1	1.0	2.0
Loops	3.3	8.2	5.7	1.0	5.2	3.1
Interdigital III:						
Vestiges	11.5	13.1	12.3	9.4	7.3	8.4
Loops	18.1	45.8	32.5	11.4	24.0	17.7
Interdigital IV:						
Vestiges	16.4	14.8	15.6	12.5	11.5	12.0
Loops	54.1	34.4	44.2	69.7	61.4	65.6

the Ayom Pygmies and the Kanaka tribes of New Guinea reported by Geipel [2] are more similar to those of the Fore than the Anga.

The frequencies of accessory triradii as shown in table 5 are not significantly different in the two groups.

The distribution of the width of the atd angles was grouped in 5° intervals and is shown in table 6 together with the actual mean and standard errors. The actual observations were tested by *t*-test, and their means were found to be significantly different, with the Fore having wider atd angles.

TABLE 5
FREQUENCY OF ACCESSORY TRIRADII IN THE PALMAR AREAS OF THE
ANGA AND FORE (%)

PALMAR AREA	ANGA			FORE		
	L	R	L + R	L	R	L + R
Hypothenar (t)	14.8	8.2	11.5	19.8	12.5	16.1
Interdigital II	3.3	8.2	5.7	1.0	5.2	3.1
Interdigital III	0	0	0	0	0	0
Interdigital IV	21.3	14.8	18.0	22.9	11.4	17.2

NOTE.—Anga, *N* = 61; Fore, *N* = 96.

TABLE 6
PERCENTAGE DISTRIBUTION OF WIDTH OF atd ANGLES IN THE ANGA AND FORE
NATIVES OF NEW GUINEA

atd ANGLE (DEGREES)											
POPULATION AND PALM	t										ACTUAL MEAN ± SE
	Absent	<35	35-39	40-44	45-49	50-54	55-59	60-64	65-69	>69	
Anga:											
Left	0	10.5	26.3	29.8	14.0	7.0	7.0	3.5	0	1.8	43.04 ± 1.2
Right	0	14.0	36.8	22.8	10.5	3.5	10.5	1.8	0	0.9	41.33 ± 1.0
Both	...	...	...	...	...	...	...	...	...	...	42.18 ± 0.8
Fore:											
Left	0	0	27.8	27.8	14.4	12.2	7.8	4.4	2.2	3.3	46.53 ± 1.1
Right	0	0	22.2	42.2	12.2	5.6	7.8	6.7	2.2	1.1	45.27 ± 0.9
Both	...	...	...	...	...	...	...	...	...	...	45.90 ± 0.7

NOTE.—Anga, *N* = 57; Fore, *N* = 90.

Palmar Creases

The frequencies of both the simian and Sydney lines are shown in table 7. The Anga show a higher incidence of both lines, although the differences are not sig-

nificant. For the calculations of the values in table 7, only complete simian and Sydney lines were considered. The aberrant and atypical ones were excluded in this report. A detailed discussion on the various forms of the palmar creases and their distributions will be reported at a later time. It should be noted, however, that the Anga have significantly higher numbers of aberrant simian and Sydney lines than the Fore.

The results of all the dermatoglyphic evaluations, for both hands combined, were summarized and presented in the form of a "cyclogram" in figure 1. We feel that this type of presentation renders itself very useful in giving a synopsis of all the comparisons among the populations under investigation. The cyclogram may also be modified to present the distribution of a single variable in a number of populations. This was done in the review of the distributions of the modal types of the C line [5].

TABLE 7
FREQUENCY OF SIMIAN AND SYDNEY LINES AMONG THE ANGA AND FORE
PEOPLES OF NEW GUINEA (%)

	ANGA					FORE				
	Left Only	Right Only	Bilat- eral	Persons	Palms	Left Only	Right Only	Bilat- eral	Persons	Palms
Simian	3.1	1.6	1.6	6.3	3.9	1.0	2.0	1.0	3.9	2.4
Sydney	7.8	6.3	1.6	15.6	8.6	2.9	5.9	2.9	11.8	7.4

NOTE.—Anga, $N = 64$; Fore, $N = 102$.

SUMMARY

Fingerprints and palm prints were collected from 102 natives of the Fore group and from 64 of the Anga group of the Eastern Highlands of New Guinea. These two peoples who live adjacent to each other are morphologically and linguistically different. Furthermore, the Fore are known for their high incidence of the disease kuru, which is absent among the Anga.

The dermatoglyphics of the two groups were compared and found to be significantly different from each other in terms of fingerprint patterns, terminations of the main lines, patterns in the III and IV interdigital areas, and amplitude of the atd angle. The Anga showed a higher number of whorls in the fingerprints and, consequently, a higher pattern-intensity index. They also demonstrated a more transverse direction in the palmar ridges than the Fore, a higher main line index, and a higher R/U ratio in the C-line terminations. The Anga showed a higher incidence of patterns in the III interdigital area, while the Fore had more patterns in the IV area. The atd angles in the Anga were found to be wider on the average than those of the Fore.

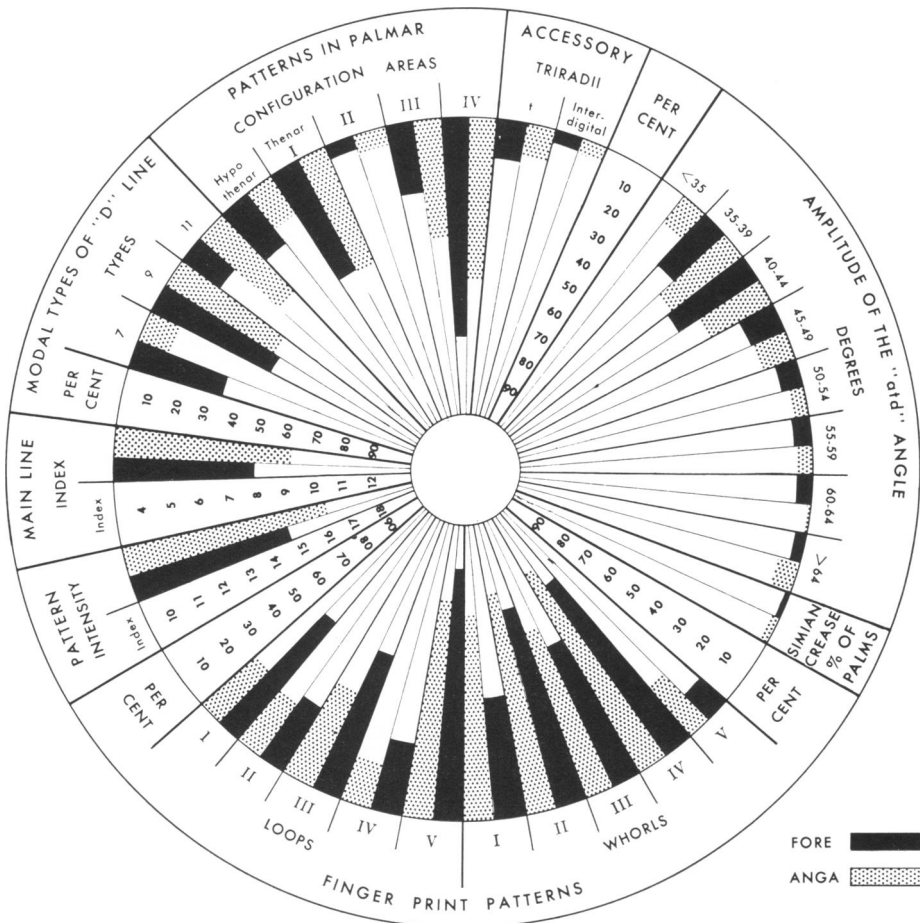


FIG. 1.—Summary of the dermatoglyphic comparisons between the Fore and Anga peoples of New Guinea.

There were no significant differences in the incidence of accessory triradii or the incidence of simian or Sydney lines.

The magnitude of the dermatoglyphic differences between the Anga and the Fore agrees with the previously described physical, maturational, cultural, and ethnolinguistic differences between these two groups. Furthermore, the dermatoglyphics of the Anga tend to be distinct, not only from the Fore but also from the Ayom and Ramu River peoples and the Hula Village peoples near Port Moresby reported by other investigators.

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